

## **PRE-CONDITIONING D'ANJOU PEARS IN TRANSIT DURING EARLY MARKETING SEASON**

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### **SUMMARY**

The optimum temperature regimes for pre-conditioning 'd'Anjou' fruit in the transportation vehicle during the first two months of shipment were investigated. 'D'Anjou' pears were harvested at commercial maturity with flesh firmness (FF) of 14 lb ( $\pm 1.0$  lb) and held in cold storage at 30 °F in air. After 0.5, 1.0, 1.5 and 2.0 months of storage, 'd'Anjou' fruit were conditioned at 45, 55 or 60 °F in a simulated container enriched with 100 ppm ethylene ( $\pm 20$  ppm) for 3 or 7 days. 'D'Anjou' stored for less than 0.5 month required a pre-conditioning temperature at 68F for a short-distance shipment (i.e., a 3-day shipment) in order to induce the swift ripening capacity at the retail markets. For the safest in-transit pre-conditioning operation, the preconditioning temperature at 45 °F was the best for a long-distance shipment (i.e., a 7-day shipment) while the pre-conditioning temperature at 60 °F was the best for a short-distance shipment during the first two months of marketing season.

### **INTRODUCTION**

Our earlier study has shown the use of quality conditioning (i.e., pre-conditioning) of 'd'Anjou' pears by packinghouses (i.e., shippers) promotes the ripening capacity so as to stimulate consumers' purchasing desirability at early marketing season. However, for many packinghouses, pr-conditioning 'd'Anjou' fruit is not an easy task particularly in the harvest period because of the intensive workload of packing and storage operation. The early harvested 'd'Anjou' fruit do not move well through marketing channels if they are not pre-conditioned with ethylene before shipment since 'd'Anjou' fruit without sufficient chilling are incapable of ripening normally at the retail markets. In this report, we initiated research to determine the optimum temperature regimes for pre-conditioning 'd'Anjou' fruit in the transportation vehicle during the first two months of shipment thereby eliminating the extra workload for the packinghouses.

### **MATERIALS AND METHODS**

'D'Anjou' pears were harvested at commercial maturity with flesh firmness (FF) of 14 lb ( $\pm 1.0$  lb) from an orchard block at Mid-Columbia Agricultural Research and Extension Center, Hood River, Oregon. Harvested fruit were transferred into cardboard boxes (44 lb/box) with polyethylene liners and held in cold storage at 30 °F in air.

After 0.5, 1.0, 1.5 and 2.0 months of storage, 6 boxes of fruit were conditioned at 45, 55 or 60 °F in a simulated container enriched with 100 ppm ethylene ( $\pm 20$  ppm) for 3 or 7 days. The concentration of ethylene in the pre-conditioning container was set at 100 ppm according to the literatures published for the induction of ripening activities of other fruit corps (Brecht and

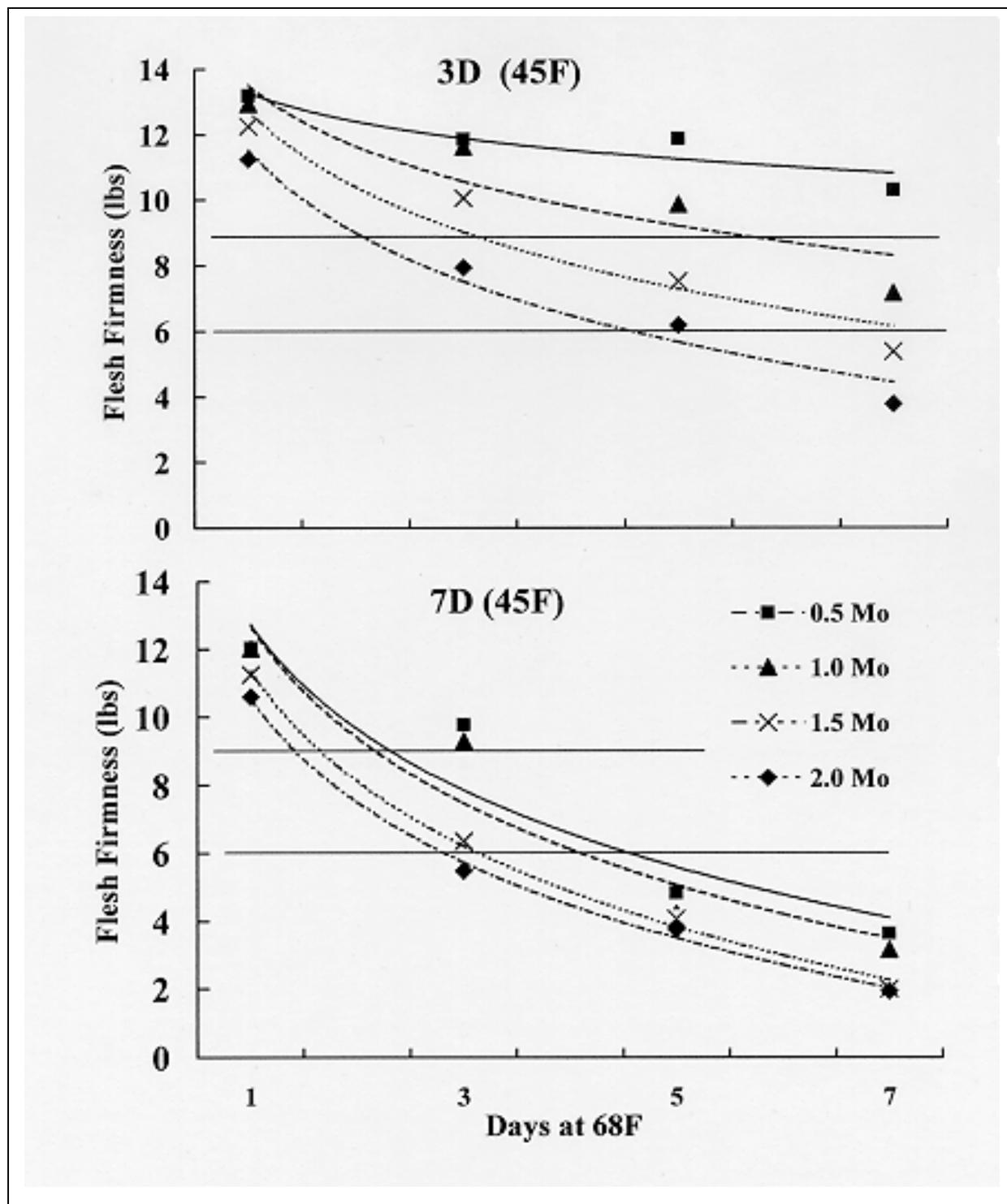
Kader, 1984a; Brecht and Kader, 1984b; Hesselman and Freebairn, 1969). After the end of 3 or 7 days of in-transit pre-conditioning treatments, treated fruit were transferred into a cold storage at 32 °F for 7 days to simulate the holding period at the terminal (distributing) point. Treated fruit were then placed in an ethylene-free room at 68 °F to simulate the ripening activities on the shelf in the retail markets. Changes in flesh firmness (FF) of the treated fruit (10 fruits per replicate) were determined on day 1, 3, 5 and 7 of ripening at 68F. An improved pressure tester, commonly referred to as the UC tester, for the determination of flesh firmness of many fruit crops has been developed by the University of California at Davis (Claypool and Fridley, 1966). Two pared surfaces away from sunny and shady sides of each fruit were penetrated perpendicularly by a UC pressure tester with a plunger (8 mm in diameter) at a steady force to a depth of 9 mm. FF with the unit of lb per square inch force of each pared punch was read directly from the gauge of the UC pressure tester. Two FF readings of each fruit were averaged. The means of FF from 3 replicates were used to determine the fruit-softening pattern at each ripening interval. The natural logarithmic function, which is a monotonically decreasing regression, was found to be better fit for most of the data than the exponential function with an asymptote-approaching zero. Therefore, the natural logarithmic function was applied to fit all the fruit softening curves.

## RESULTS AND DISCUSSION

Two important criteria must be considered for pre-conditioning 'd'Anjou' pears in transit. First, pre-conditioned fruit should remain firm with no risk of bruising in transit and during distributing to the retail markets. Second, pre-conditioned fruit should be able to ripen swiftly with desirable dessert quality on the shelf in the retail markets within a few days (preferably no longer than 5 days). Slaughter et al. (1999) have retorted that 'Bartlett' pears packed in a single layer box using a plastic tray and bubble plastic padding are protected from transit vibration bruising if their firmness is greater than about 101b. Mitcham et al. (1999) have conducted a commercial in-transit quality conditioning (i.e., pre-conditioning) treatment of 'Bartlett' pears. They have concluded that the commercial in-transit quality conditioning trail of 'Bartlett' pears have achieved the goal to meet the intense demand of high dessert quality of the ripened pear fruit by the consumers during early marketing season. The previous study has shown that 'd'Anjou' pears softened to 6 lb develop juicy texture with acceptable flavor during ripening at 68 °F (data not presented). In this study, the successful in-transit preconditioning treatment of 'd'Anjou' pears was set at the prerequisite condition that the flesh firmness of pre-conditioned fruit must be no less than 9 lb on day 1 of ripening at 68 °F and no more than 6 lb on day 5 of ripening at 68 °F. This prerequisite condition would allow the retailers to handle the partially ripened 'd'Anjou' fruit without risk of bruising damage while the consumers can enjoy the fully ripe fruit shortly after purchasing.

Assuming it requires 3 days for a short-distance shipment from the shipping point (i.e., the packing house) to the terminal distributing point and 7 days for a long-distance shipment. At the in-transit temperature of 45 °F, regardless of storage interval, 'd'Anjou' fruit could meet the prerequisite condition for a long-distance shipment but only the fruit stored for 2 months could meet the prerequisite condition for a short-distance shipment (Figure 1). Fruit stored for less than 2 months could not soften to a proper ripeness within 5 days at 68 °F after 3-day in-transit preconditioning treatment (Figure 1).

**Figure 1.** Changes in flesh firmness (FF) of 'd'Anjou' pears during 7 days of ripening at 68 °F. 'D'Anjou' fruit had been conditioned in a simulated container enriched with 100 ppm ethylene at 45 °F in transit for either 3 days (i.e., short distance shipment) (3D) or 7 days (i.e., long distance shipment) (7D) after 0.5, 1.0, 1.5 and 2.0 months of air storage at 30 °F.



At the in-transit temperature of 55 °F, 'd'Anjou' fruit stored for 0.5 or 1.0 month could meet the prerequisite condition for a long-distance shipment (i.e., 7-day in-transit pre-conditioning treatment) and again only the fruit stored for 2 months could be pre-conditioned in transit for a short-distance shipment (i.e., 3-day in-transit pre-conditioning treatment) (Figure 2). Fruit stored for 1.5 and 2.0 months softened to less than 8 lb after 7-day in-transit pre-conditioning treatment and became a risk of bruising during handling. Fruit stored for 0.5 or 1.0 month were not capable of softening to 6 lb on day 7 of ripening at 68 °F after 3-day in-transit pre-conditioning treatment (Figure 2).

At the in-transit temperature of 60 °F, 'd'Anjou' fruit stored for 1 month or longer could be successfully pre-conditioned for a short-distance shipment (i.e., 3-day in-transit pre-conditioning treatment) (Figure 3). Fruit stored for 0.5 month required 7 days of ripening at 68 °F to soften to 6 lb if they were conditioned for 3 days in transit as a short-distance shipment (Figure 3). Regardless of storage intervals, 'd'Anjou' fruit had softened to less than 9 lb on day 1 at 68 °F and thus became too soft to be handled safely in the retail markets after a long distance shipment (i.e., 7-day in-transit pre-conditioning treatment) regardless of storage intervals (Figure 3).

It was clear that 'd'Anjou' stored for less than 0.5 month might require a pre-conditioning temperature at 68 °F for a short-distance shipment in order to meet the prerequisite condition. For the safest in-transit pre-conditioning operation, the pre-conditioning temperature at 45 °F was the best for a long distance shipment while the pre-conditioning temperature at 60 °F was the best for a short distance shipment.

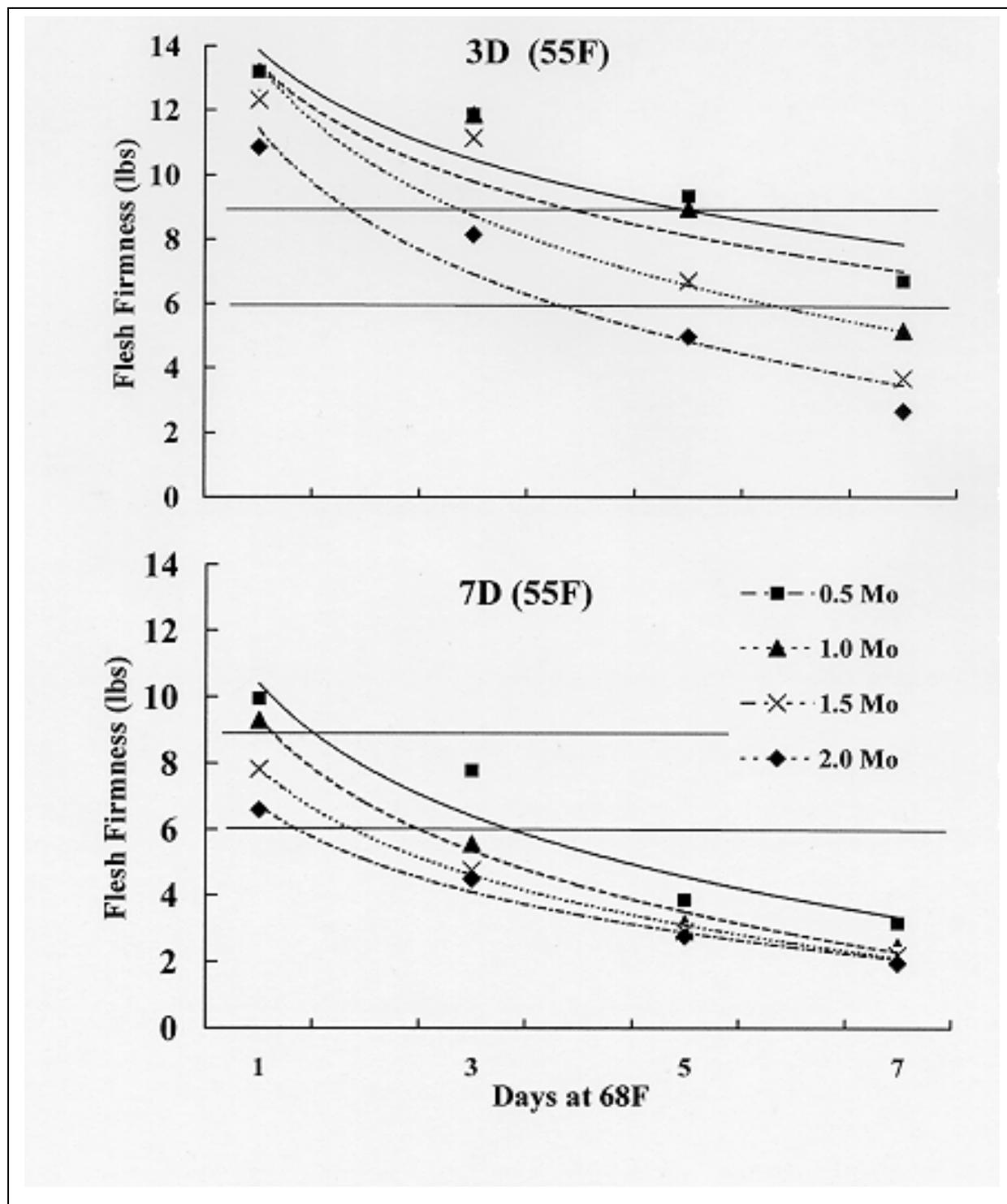
### ***Acknowledgement***

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### **REFERENCES**

- BRECHT, J.K. and KADER, A.A. 1984a. Ethylene production by 'Flamekist' nectarines as influenced by exposure to ethylene and propylene. *J. Amer. Soc. Hort. Sci.* 109:302-305.
- BRECHT, J.K. and KADER, A.A. 1984b. Regulation of ethylene production by ripening nectarine fruit as influenced by ethylene and low temperature. *J. Amer. Soc. Hort. Sci.* 109:869-872.
- CLAYPOOL, L.L. and FRIDLEY, R.B. 1966. Precision in a pressure tester. *Western Fruit Grower* 20:18-19.
- HELSELMAN, G.W. and FREEBAIRN, H.T. 1969. Rate of ripening of initiated banana as influenced by oxygen and ethylene. *J. Amer. Soc. Hort. Sci.* 94:635-637.
- MITCHAM, E., AGAR, T., BIASA, B., THOMPSON, J. and SLAUGHTER, D. 1999. Quality conditioning and ripening of Bartlett pears. 1999 California Pear Research Reports. Pp. 323-342.
- SLAUGHTER, D., THOMPSON, J. and MITCHAM, E. 1999. Feasibility of shipping preripened pears to market. 1999 California Pear Research Reports. Pp. 345-350.

**Figure 2.** Changes in flesh firmness (FF) of 'd'Anjou' pears during 7 days of ripening at 68 °F. 'D'Anjou' fruit had been conditioned in a simulated container enriched with 100 ppm ethylene at 55 °F in transit for either 3 days (i.e., short distance shipment) (3D) or 7 days (i.e., long distance shipment) (7D) after 0.5, 1.0, 1.5 and 2.0 months of air storage at 30 °F.



**Figure 3.** Changes in flesh firmness (FF) of 'd'Anjou' pears during 7 days of ripening at 68 °F. 'D'Anjou' fruit had been conditioned in a simulated container enriched with 100 ppm ethylene at 60 °F in transit for either 3 days (i.e., short distance shipment) (3D) or 7 days (i.e., long distance shipment) (7D) after 0.5, 1.0, 1.5 and 2.0 months of air storage at 30 °F.

